mentioned above. In addition, there are indications of pervasive near-surface ice at mid-to-high latitudes, widespread, ice-rich veneers cover most the surface also at mid-to-high latitudes, and glaciation may have occurred locally. Also, much of the ice presently at the poles appears to have accumulated late during the Amazonian.

At mid-to-high latitudes ice is unstable at the surface because summer daytime temperatures rise above the frost point. However, daily temperature fluctuations damp out rapidly with depth, and modeling suggests that water ice is stable a few tens of centimeters below the surface, the depth depending on the latitude and the thermal inertia of the materials overlying the ice (Farmer and Doms, 1979). As expected, at latitudes higher than 60°, neutron and gamma-ray spectrometer measurements detected large fractions of ice at depths of tens of centimeters below a dehydrated layer (Feldman et al., 2004), and the presence of an ice table centimeters below the surface was confirmed by the Phoenix lander. Comparably large fractions of ice are not detected by orbiter spectrometers at latitudes much lower than 60° although geologic indicators of ground ice, such as debris aprons, are present down to latitudes as low as 30°. The observations suggest that significant amounts of near-surface ice may be present down to latitudes as low as 30°, but at depths too deep to be detected by the spectrometers.

The stability of ice at the surface is sensitive to the obliquity cycle. During periods of high obliquity ice tends to be driven from the poles to be deposited at lower latitudes (Jakosky and Carr, 1985; Mellon and Jakosky, 1995). The reverse occurs at low obliquities. During the current epoch, the obliquity oscillates between 15° and 35° about a mean of 24°, but Laskar et al., (2004) estimate that the average obliquity over geologic time is 40° and that there is a 63% probability that the obliquity reached 60° in the last 1 Gyr. At the current obliquity, ground ice should not be present at latitudes lower than 40° latitudes. Indicators of ice at latitudes as low as 30° may indicate that the ground ice has equilibrated with the more common higher obliquity conditions.

Most of the terrain in the 30–55° latitude belts is covered with a thin (~10 m) veneer of material that forms a smooth surface where still intact and finely pitted surfaces were partly removed (Mustard et al., 2001). Head et al. (2003) suggested that it is an ice–dust mixture deposited during a recent era of higher obliquities 0.4–2 Myr ago and that it is now in the process of being removed. Much thicker, possibly ice-rich deposits occur preferentially on pole-facing slopes at midlatitudes (Carr, 2001). If thick enough, such deposits could flow to form glaciers. They have been invoked as a source of water that cut the gullies that commonly occur on steep slopes, as discussed below (Christensen, 2003).

Lobate debris aprons adjacent to most steep slopes in the 30°–55° bands in both hemispheres (Squyres, 1979) are compelling indicators of the presence of ice (Figure 2.7). They typically have convex-upward surfaces, are roughly 500 m thick adjacent to the slope at their origin, and extend about 20 km away from the slope. Their radar properties are identical to those of the polar layered terrains, strongly suggesting large fractions of ice (Plaut et al., 2008). Numerous surface textures indicate flow away from the slopes, with the aprons commonly wrapping around obstructions or converging on gaps in obstacles to the flow. Similar features are not found at latitudes less than 30° where talus normally simply accumulates on slopes at the angle of repose. Mangold et al. (2002) suggested on the basis of experimental